Development of Alcohol Detection with Engine Locking and Short Messaging Service Tracking System

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Samuel Owoeye
Federal University of Agriculture

Folasade Durodola
federal university of agriculture, abeokuta, nigeria

Adedayo Akinade
Federal University of Agriculture

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Samuel Owoeye
Department of Mechatronics Engineering,
Federal University of Agriculture
Abeokuta, Nigeria
owoeyeso@funaab.edu.ng

Folasade Durodola
Department of Computer Engineering
Obafemi Awolowo University
Ile-Ife, Nigeria
fodurodola@pg-student.oauife.edu.ng

Adedayo Akinade
Department of Mechatronics Engineering,
Federal University of Agriculture
Abeokuta, Nigeria
akinadeadedayo1@gmail.com

Ahmad Alkali
Department of Mechatronics Engineering,
Federal University of Agriculture
Abeokuta, Nigeria
alikaliahm@gmail.com

Olaitan olaonipekun
Department of Mechatronics Engineering,
Federal University of Agriculture
Abeokuta, Nigeria
olaonipekun74@gmail.com

Abstract- **Road travelling is among the simplest modes of transportation. Accidents are frequently the consequence of a human error on the road, and they can occasionally be brought on by alcohol intake which alters the victim's way of thinking. Law enforcement agencies have made significant efforts to lower the risk of drunk driving, but none have been able to significantly diminish it. Due to this, the proposed system was developed to lessen the likelihood of accidents on our roads being brought on by intoxicated drivers. The device can prevent a drunk driver from operating the vehicle and, in the event of an accident, send a message to a pre-programmed number informing it of the location of the vehicle. The entire software is built around a microcontroller, an alcohol sensor, and a vibration sensor. The sensor is used to set an alcohol threshold at which an alarm will buzz, and when the set threshold is exceeded, the flow of fuel to the engine will cease, thereby bringing the car to a halt. In case of an auto crash, the microcontroller would receive input from the attached vibration sensor, and send the location of the vehicle to a pre-registered phone number on the subscriber identification module (SIM) of the project. This project is a prototype of what is proposed in a vehicle where the DC motor serves as the fuel pump.**

Keywords: Alcohol, Accidents, Road safety, Microcontroller, drunk driving, road crashes, Nigeria

I. INTRODUCTION

Drinking and driving is a major public health issue and it is already becoming one of the most serious issues that road users face [1]. In Nigeria, the problem is being addressed by enacting legislation forbidding drivers from getting intoxicated before or while driving, as well as entrusting law enforcement authorities with the task of arresting and prosecuting offenders [2]. Effective monitoring of inebriated drivers is a complex task for law enforcement agencies like the police or road safety officials since they are unable to immediately verify complete obedience to the law by the driver [2]. The World Health Organization (WHO) estimates that road traffic accidents are the eighth leading cause of death for persons of all ages and the top cause of death for those under 30 years old [3]. Around 1.3 million people worldwide lose their lives in motor vehicle accidents every year, and another 20 to 50 million are injured. Although developing countries account for only 54% of the world's registered vehicles, 90% of road traffic fatalities occur therein [4]. As a result, an autonomous alcohol detection device that can operate without regard to place or time is required. Drunk driving is an extremely risky behavior because excessive alcohol intake leads to the distortion of the driver's cognitive patterns [5]. The number of traffic accidents due to drunk driving has risen dramatically in recent years. As a result, it has become clear that intoxicated driving endangers public safety [6].

According to Nigeria's top road safety organization, the Federal Road Safety Corps (FRSC), 69,941 crashes were reported on Nigerian roadways between 2011 and 2016, resulting in 35,179 fatalities. [7]. Although the research indicated that speeding was the leading cause of these accidents, it is fair to assume that the majority of the incidents were due to the driver's unstable condition, which was caused by their being intoxicated before driving [6]. According to a study conducted by the World Health Organization in 2008, drink-driving is responsible for 50 to 60 percent of road accidents. Furthermore, according to WHO data on traffic mortality, 1.25 million people died in traffic in 2013, with low- and middle-income nations having higher fatality rates per 100,000 population (24.1 and 18.4, respectively) [8,9]. According to the data obtained, 67.2 percent of commercial vehicle drivers in Nigeria acknowledged drinking alcohol while on the job [10]. This demonstrates that most drivers, particularly commercial and heavy-duty truck drivers, drink and drive, which can result in an accident [6]. Regularly, new safety features are being created to make them safer for consumers. However, because of one item, an accident people continue to feel unsafe and fearful of these cars. According to research, the majority of accidents occur when people are under the influence of alcohol, and no technology can reduce the likelihood of an accident [11]. To avoid this problem, vehicle alcohol and accident detection with engine locking and GPS tracking system are introduced.

James and John [5] designed a gadget that detects alcohol and sends a text message to the driver's phone. Two of the system's most important components were the GSM and LM358 modules. Because it was based on GSM technology and employed a GSM module instead of an alarm circuit while still using the LM358 Op-Amp, this device was a considerable step ahead of the earlier breath analyzer. To deliver text messages to the mobile phone, the system employed a GSM module with a customized ringtone. Its biggest fault was the absence of an LCD and an alarm circuit, both of which may be useful in instances where the driver's phone is lost. Another downside is the use of a comparator rather than a microcontroller to alter the BAC threshold due to the likelihood of changes in the driver's body chemistry. The topic of cell phone batteries dying comes up as well, which means that if a cell phone battery dies, the system will be rendered inactive. Furthermore, the ability of the work to notify was impeded since most drivers placed their phones in vibration or silent mode when driving [13]. Phani, 2014 [14] designed a new alcohol detection gadget based on the PIC16F877A microcontroller. The microcontroller enables simple threshold changes depending on body chemistry. The microcontroller's incorporation allowed for the inclusion of extra attributes at a later time. The alcohol sensor would not have had the chance to gain a minimum of 3 hours of charge time if supplied by a DC power source (car battery) to give it the degree of precision it needed for its functioning if driven by an AC power supply [10]. Pranjali et al., [15] employed an Arduino ATMEGA328 controller board that was coupled to an MQ-3 alcohol sensor module, GPS, GSM, LCD, and DC motor. The GPS module saves a vehicle's location and sends it as a distress signal to the GSM module. The LCD is used as a display, and the DC motor is used to determine the mechanism's ability to keep the engine inoperable if ethanol is observed. Shafi et al. [16] introduced Virtual Instrumentation for an automated vehicle engine lockout control system. In the suggested system, an alcohol breath analyzer was constructed using LabVIEW. An MQ-3 sensor was used as a breathalyzer, and an Arduino was used as the control unit. LEDs and LCDs were used as output devices. ZigBee, IoT, and LabVIEW software are among the other technologies employed. Thanks to the Internet of Things, anxious family members of imprisoned drunken suspects can get e-mail. Vijay et al. [17] demonstrated a system that used a GPS to track the car's location, a cardiac pulse sensor warning the driver of normal or abnormal circumstances, and a bumper switch to detect vehicle collisions. Among the numerous functional modules attached to the ATmega328 controller are GSM, GPS, LCD, MQ-3 alcohol sensor, obstacle sensor, fuel blocker, alarm, and relays.

This technology is designed to monitor the breath of drivers using an alcohol sensor that may be positioned near the driver. If the driver is inebriated and attempts to drive, the system will detect alcohol in the driver's breath and shut off the fuel pump, preventing the car from starting [12]. In another scenario, if the driver is not inebriated when the engine is started and the car begins to move, and while on the wheel the driver starts drinking, the system will detect the smell of alcohol, and then halt the movement of the vehicle by stopping the flow of fuel into the engine, allowing the driver to move the car to the side way. This project is capable of more than only detecting alcohol because it has a GSM and GPS modem, an infrared (IR) sensor, and a vibration sensor that sends a message to a pre-programmed number with the driver's position and a message dialogue for detecting alcohol or an accident. In addition, the IR sensor will prohibit the driver from starting the car without wearing a seat belt, assuring the driver's safety and compliance with safety regulations.

2. Materials and Methods

The project's software and hardware design process are presented in this section. The two primary pieces of software used for this project were Proteus and Arduino. Proteus simulation was used to examine the system's performance prior to hardware design.

2.1. Materials.

The followings are the components used in the development of the system;

- Arduino Uno Board
- GSM Module (SIM 900A)
- GPS Module (Neo-7m)
- LCD (16X2 I2C MODULE)
- Mini Pump (3-5 VOLT)
- Alcohol Sensor (MQ-3)
- Vibration/Tilt Sensor (SW-1080)
- IR Sensor (HW-201)
- Buzzer (3-24 VOLT DC)
- Adaptive box and Container
- Power Bank (5V 2A OUTPUT)
- Relay module (5V ONE-WAY CHANNEL)
- Reset switch
- Power switch

The followings are the components used in the development of the system;

- Arduino Uno Board: This microcontroller board is based on the ATmega328p microprocessor from Microchip. The board has 6 analog I/O pins and 14 digital I/O pins. It may be programmed with the Arduino IDE using a USB type-B connector, which can also be used to connect it to power. Additionally, it may be powered by external batteries with a voltage range of 7 to 20 volts [18,19]. This serves as the project's main processing unit and integrates all the other elements. The open-source electronics platform Arduino has user-friendly hardware and software. Various microprocessors and controllers are used in the designs of Arduino boards. The boards have a variety of extension boards ('shields'), breadboards (for prototyping), and other circuits that can interact with the sets of digital and analog input/output (I/O) pins on the boards. The boards have serial communications interfaces, some of which, on certain versions, include a Universal Serial Bus (USB), which is also used to load software from personal computers. Programming languages C and C++ are suitable for use with microcontrollers. The Arduino project offers a built-in development environment (IDE) based on the Processing language project in addition to utilizing conventional compiler toolchains.

- GSM Module (SIM 900A): A typical cellular radio called a Global System for Mobile Communications (GSM) modem uses telephone networks to send SMS and IP data. They are specialist wireless modems that function similarly to a mobile phone on subscription-based wireless networks. A GSM modem functions as a mobile phone for a computer by accepting a Subscriber Identity Module (SIM) card [20,21]. Even a specialized mobile phone that the computer utilizes for GSM network capabilities can serve as such a modem. When a GSM modem is linked to a computer, the computer may communicate via the mobile network using the GSM modem. Although mobile internet access is the most common usage for these GSM modems, many of them may also be used to send and receive SMS and MMS messages.

- GPS Module (Neo-7m): The most popular satellite navigation system in use today is the Global Positioning System (GPS). Geolocation, time, and velocity data are all provided by this GNSS, or global navigation satellite system [22]. Since its introduction in 1994, GPS has been in use all across the world. The most recent GPS receivers offer geolocation with a 30-centimeter accuracy. The United States Space Force is in charge of maintaining and owning the GPS on behalf of the US government.
Over 30 Medium Earth Orbit (MEO) satellites make up the GPS constellation. These satellites continually broadcast signals that a GPS receiver may pick up across certain RF frequencies. Anywhere on earth, a GPS receiver may determine its position in latitude and longitude by calculating its distance from four or more satellites. The capabilities of the various types of GPS receivers vary. In essence, all GPS receivers can transmit their geolocation, UTC, and velocity data. The most recent GPS receivers are incredibly small and more precise than before. These little gadgets are already included in the majority of cell phones and offer geolocation, time, and velocity data at no charge. Additionally, GPS receivers are used in cars, to track

trade, and in a variety of tracking applications including those for drones and unmanned aerial vehicles.

- LCD (16X2 I2C MODULE): Liquid-crystal displays are flat-panel displays or optical systems that use electronically controlled light and liquid crystals in conjunction with polarizers (LCD). Instead of directly emitting light, liquid crystals need a backlight or reflector to produce images that can be either color or monochromatic. Some LCDs can display fixed images with little information content that may be seen or hidden, or random visuals (as on a general-purpose computer display). Think of this: These displays are used by gadgets with pre-programmed text, numbers, and seven-segment displays like a digital clock.

- Mini Pump (3-5 VOLT): This DC 3-5V Mini Micro Submersible Water Pump is a low-cost, small-size Submersible Pump Motor that can be operated from a 2.5 ~ 5V power supply. It is being used to simulate the fuel pump to be used.

- Alcohol Sensor (MQ-3): If an alcohol sensor finds alcohol gas in the surrounding area, an analog voltage reading is generated. The sensor can switch on in the temperature range of -10 to 50 °C with a power supply of less than 150 Ma to 5 V. The acceptable sensing range for breathalyzers is 0.04 mg/L to 4 mg/L [23]. Detecting ethanol in the air is the function of the MQ3 sensor, which is the alcohol sensor's official name. When a drunk person breathes near the alcohol sensor, the sensor detects the ethanol in his breath and generates an output based on how much alcohol is in his system. With alcohol consumption, the LEDs shine brighter.

- Vibration/Tilt Sensor (SW-1080): Piezoelectric accelerometers called vibration sensors to detect vibration. They are used to quantify regular vibrations as well as varying accelerations or speeds. This sensor converts changes in acceleration, pressure, temperature, force, or strain into an electrical charge by using the piezoelectric effects [24]. It uses several mechanical or optical operating principles to identify system vibrations that have been noticed.
  There are both lower and higher sensitivities available for this sensor, which typically have a sensitivity range of 10 mV/g to 100 mV/g. The program will determine which sensor sensitivity should be used. Therefore, it is crucial to be aware of the range of vibration amplitude levels to which the sensor will be subjected during measurements.

- IR Sensor (HW-201): The IR sensor, also known as an infrared sensor, is a type of electronic part that emits or detects IR radiation to identify certain features in its environment [25]. The heat and motion of a target can also be detected or measured using these sensors. The IR sensor circuit is a crucial component in many electrical gadgets. The visionary senses used by humans to identify barriers are similar to this type of sensor. The term PIR, or passive infrared, refers to the sensor that just measures IR radiation rather than emitting it. In general, all targets' radiation and some types of thermal radiation in the IR spectrum are invisible to the human eye but may be detected by IR sensors.

- Buzzer (3-24 VOLT DC): A mechanical, electromechanical, or piezoelectric buzzer or beeper is a device used for auditory signaling (piezo for short). Alarm clocks, timers, and confirmation of human input, such as a mouse click or keyboard, are common applications for buzzers and beepers.

The block diagram of the implemented system is shown in figure 1 below;

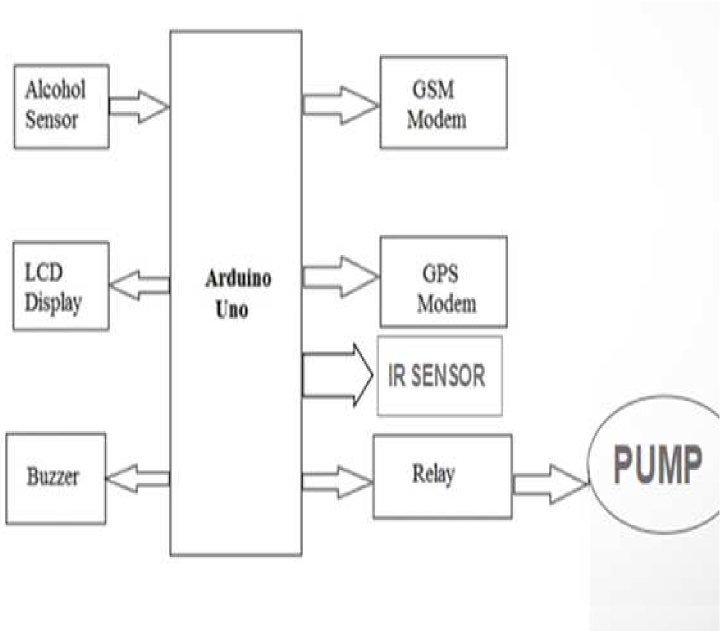

Figure 1: Block Diagram of the implemented system

The flow diagram of the alcohol detection system is shown in figure 2 below;

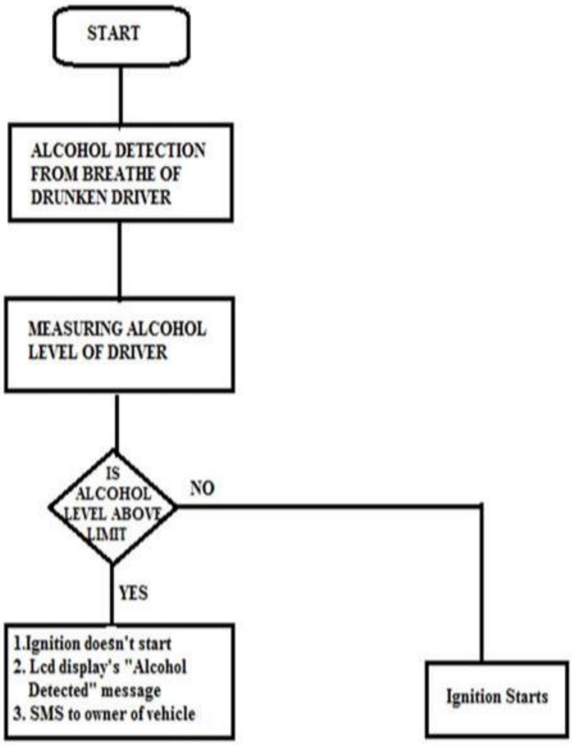

Figure 2: Flow chart of Alcohol Detection

The flow diagram of the GSM notification system is shown in figure 3 below;

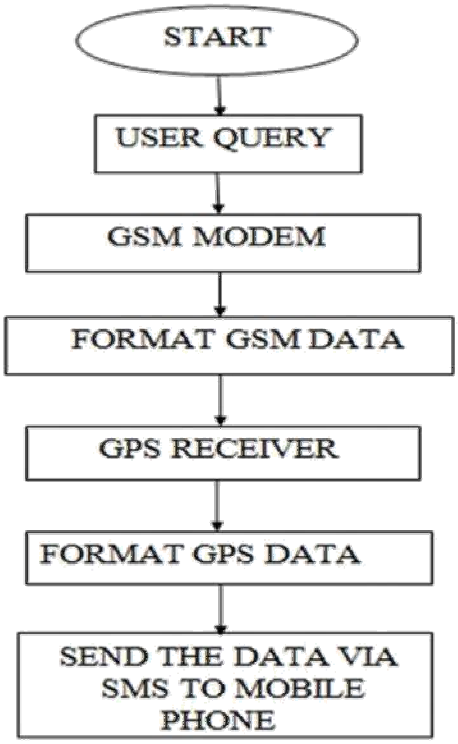

Figure 3: Flow chart of GSM

The schematic diagram of the electronic circuitry system is shown in figure 4 below;

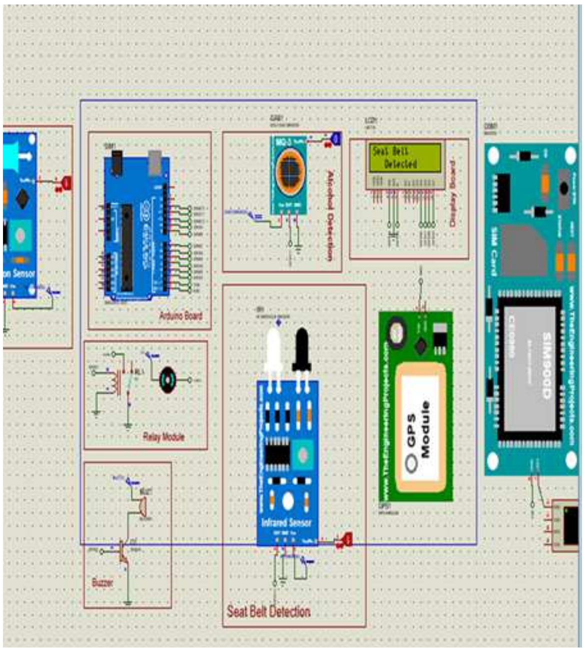

Figure 4: Circuit diagram of the GSM module system

2.2. Working Principle

The device starts with the LCD displaying "ALCOHOL, SEATBELT AND ACCIDENT SENSING WITH GPS TRACKING SYSTEM", a signal is sent to the IR sensor which acts as a seat-belt prototype to begin working, if no object is detected near the IR sensor the LCD indicates "NO SEAT BELT DETECTED" else it displays "START ENGINE SAFE DRIVE".

The alcohol sensor starts sensing the presence of alcohol in its environment, if no alcohol is detected, a signal is sent to the DC pump which serves as a prototype representing the fuel pump that supplies fuel to the engine of the car and also displays "NO ALCOHOL DETECTED" on the LCD screen

If the alcohol sensor detects alcohol that is above the programmed limit which is 0.05 g/dl, the LCDs, "ALCOHOL DETECTED", "ENGINE OFF DON'T DRIVE!!", the microcontroller sends a signal to the relay to cut off supply to the mini pump, then a signal is sent to the GPS module to read the location of the event and register it into the Arduino board which then controls and in return send signals to the GSM module to send the recorded location of the event as SMS to the registered phone number programmed to.

The accident sensor starts detecting. The vibration/tilt sensor reads from 0-1023 Hz when there is no impact detected by the sensor, once it starts to detect vibrations the readings begin to decrease accordantly. Once the vibration of the sensor is been tilted, and the readings are less than 800 Hz the microcontroller immediately sends a signal to the relay to turn off the mini pump and the buzzer is been activated at the same time, the LCD will display "ACCIDENT ALERT!!! ARE YOU OKAY?". The micro-controller waits for about ten seconds (10 sec) for a response from the reset button, once it doesn't get any response it gets the location coordinates from the GPS module and sends it to the GSM module as a signal which in turn sends an SMS to the programmed phone number with details of the event and the co-ordinates and the LCD will show "ACCIDENT ALERT SENDING SMS", once the SMS is sent, the LCD will display "MESSAGE SENT". If the microcontroller receives a response from the reset button within ten seconds, the LCD will display "GOOD TO KNOW YOU ARE OKAY" and the microcontroller resets to an initial state and runs all over again.

3. Results

Figure 5 below shows the result of the system display upon start-up and the seat belt engaged.

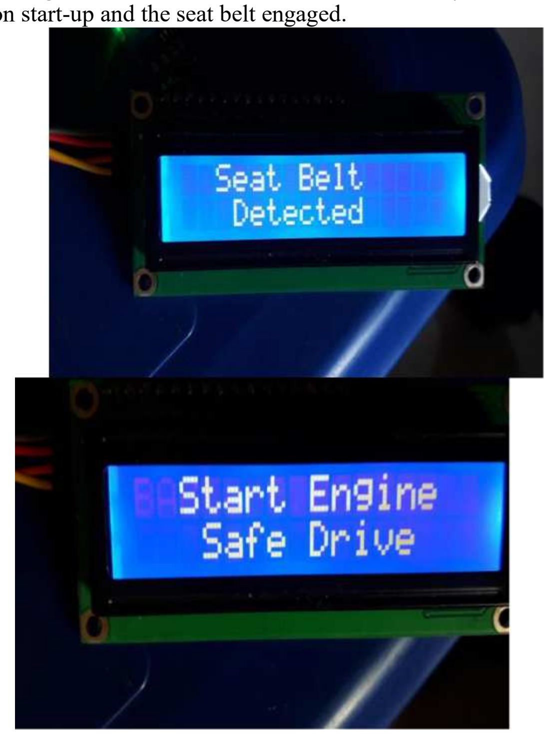

Figure 5: Start-up Display of the System

The following tables below show the test and results carried out after the completion of the projects Table 1 shows the test carried out before the engine starts which shows that for the engine to start running the seat belt must be activated and the alcohol sensor must read a BAC below 0.05, otherwise the engine will not start. Figure 6 below shows the display in a situation where alcohol is detected.

Table 1: System Test Results with Alcohol Detection

;	ACTION/DISPLAY	ENGINE STATUS
	Seat belt not detected Alcohol detected (BAC > 0.05)	OFF
	Seat belt detected Alcohol not detected (BAC </= 0.05)	ON

Figure 6: LCD Display when alcohol is detected

The below result (Table 2) was recorded after starting up the engine;

Table 2: System Test Results with Accident Detection

S/N	ACTION/DISPLAY	ENGINE STATUS
1	Seat belt detected Accident detected (Vibration < 800)	OFF
2	Seat belt detected Accident not detected (Vibration >/= 800)	ON

Table 3 shows the test carried out when the engine is already working, and for this, the result shows that the engine will stop working whenever alcohol is being detected or an accident is being detected due to vibrations or both alcohol and accident were detected together. When this happens the GSM and the GPS Modules automatically send messages to the pre-registered number.

Table 3: System Test Results with Alcohol and Accident Detection

S/N	ACTION/DISPLAY	ENGINE STATUS	MESSAGE
	Seat belt detected Alcohol detected (BAC > 0.05) Accident not detected (Vibration >/= 800)	STOP	Alcohol detected, with location
	Seat belt detected Alcohol not detected (BAC </= 0.05) Accident detected (Vibration < 800)	STOP	Accident detected, with location
	Seat belt detected Alcohol detected (BAC > 0.05) Accident detected (Vibration < 800)	STOP	Accident and alcohol detected, with location

Figure 7 shows the display in the event of an accident.

Figure 7: LCD Display in Event of an Accident

4. Conclusion

In conclusion, the project "Development of Alcohol sensing with GPS Tracking System" will be able to reduce or eliminate the issue of road accidents due to drunk drivers, thereby, reducing the loss of lives and property.

Road Safety Officers may incorporate this system into their requirement which every vehicle must have before driving on our roads to monitor the driver and thereby increasing their efficiency and that of other law enforcement agencies.

We recommend that more research work should be carried out regarding this project to have a well-designed prototype that can be integrated into a vehicle. The project can be advanced further into the Internet of Things (IoT) base.

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